

### III. REMARKS

As an initial matter, the Examiner has yet to acknowledge Applicants' priority claim.

Applicants respectfully request that the Examiner acknowledge Applicants' priority claim.

Applicants gratefully acknowledge the Examiner's determination that original claim 7 contains allowable subject matter (Office Action, dated July 9, 2008, at 10, lines 1-4).

With the above amendments, the specification has been amended to incorporate the International application by reference in accordance with Preliminary Amendment (A), filed September 25, 2006. The specification has also been amended to improve clarity as "Patent Document 1" and "Patent Document 3," as these terms are used in Applicants' original specification, refer to the same document. A substitute specification in compliance with 37 C.F.R. §1.125 is attached. The attached substitute specification contains no new matter.

Claims 5, 8 and 9 have been cancelled without prejudice. Claims 1, 3, 6, 7 and 10-13 have been amended, and new claims 15 and 16 have been added. Specifically, independent claim 1 has been amended to improve grammar and clarity, and to incorporate subject matter from original claims 5, 8 and 9. Claim 1 has also been amended to recite

“wherein the first link mechanism is operable to swing back and forth in the carrying direction of the panel due to the slide mechanism and the second link mechanism is operable to swing back and forth in the carrying direction of the panel due to the first link mechanism,

wherein the first link mechanism and the second link mechanism swing back and forth in the carrying direction of the panel by changing a relative distance between the feed slide and the swing side in the carrying direction of the panel, and

wherein the first link mechanism and the second link mechanism move back and forth in the carrying direction of the panel by moving the feed slide and the swing slide in the carrying direction of the panel”

as supported on page 12, line 12, to page 18, line 18, and by Figures 3 to 5E, of Applicants' disclosure as originally filed.

Claim 3 has been amended to improve clarity, and not for a reason related to patentability. Therefore, the present amendment has no further limiting effect on the scope of

claim 3. Claims 6, 7, 10 and 13 have been amended to depend upon claim 1. Claims 10 and 13 have been further amended to improve clarity and in accordance with amendment to claim 1. Claims 11 and 12 have been amended to depend upon claims 10 and 2, respectively, and to improve clarity and in accordance with amendment to claim 1. Claims 10 and 12 have been further amended to recite that “the first translatable actuator of the slide mechanism and the second translatable actuator of the swing mechanism are arranged in parallel” as supported on page 12, lines 12-27, and by Figure 3, of Applicants’ disclosure as originally filed.

New independent claim 15 incorporates subject matter from original claims 1 and 5, and corresponds to original claim 5 rewritten in independent form. Therefore, new claim 15 has the same scope as original claim 5.

New independent claim 16 incorporates subject matter from original claims 1, 5 and 7, and corresponds to original claim 7 rewritten as an independent claim. Therefore, new claim 16 has the same scope as original claim 7.

The present amendment adds no new matter to the above captioned application.

**A. The Invention**

The present invention pertains broadly to a “panel carrying device” such as may carry a panel to be molded in a press, and the like. In accordance with an embodiment of the present invention, a panel carrying device is provided that has features recited by independent claim 1. In accordance with another embodiment of the present invention, a panel carrying device is provided that has features recited by independent claim 15. In accordance with yet another embodiment of the present invention, a panel carrying device is provided that has features recited by independent claim 16. Various other embodiments, in accordance with the present invention, are recited by the dependent claims.

An advantage provided by the various independent and dependent embodiments of the present invention is that a panel carrying device is provided that is capable of imparting different motions to press stations, has a lighter moveable portion, operates at higher speeds than conventional panel carrying devices, and that has a relatively rigid moveable portion that suppresses vibration and deflection.

**B. The Rejections**

Claims 10 and 12 stand rejected under 35 U.S.C. § 112, second paragraph, as indefinite.

Claims 1-3, 8 and 12-14 stand rejected under 35 U.S.C. § 102(b) as anticipated by Hofele et al. (U.S. Patent 5,842,370, hereafter, the “Hofele’370 Patent”).

Claims 4-6 and 9-11 stand rejected under 35 U.S.C. § 103(a) as obvious over Hofele et al. (U.S. Patent 5,842,370) in view of Terpstra (U.S. Patent 6,428,267, hereafter the “Terpstra Patent”) and Smith, Jr. et al (U.S. Patent 4,345,864, hereafter the “Smith Patent”).

Applicants respectfully traverse the Examiner’s rejections and request reconsideration of the above-captioned application for the following reasons.

**C. Applicants’ Arguments**

In view of the present amendment, claims 1-4, 6, 7 and 10-16 are in compliance with 35 U.S.C. § 112.

Independent claim 16 corresponds to original claim 7 rewritten in independent form. Therefore, claim 16 is allowable for the reasons of record.

**i. The Section 102 Rejections**

Anticipation under 35 U.S.C. § 102 requires showing the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim. Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick, 221 U.S.P.Q. 481, 485 (Fed. Cir. 1984). The Examiner has failed to establish a prima facie case of anticipation against independent claims 1 and 15 because, as admitted by the Examiner (Office Action, dated July 9, 2008, at 8, lines 5-9), the Hofele’370 Patent does not teach, or suggest, a “slide mechanism” that comprises a “translatory actuator that drives the feed slide in the carrying direction of the panel” as recited by independent claims 1 and 15 of the above-captioned application.

For all of the above reasons, the Examiner has failed to establish a prima facie case of anticipation against Applicants’ claimed invention.

**ii. The Section 103 Rejections**

A prima facie case of obviousness requires a showing that the scope and content of the prior art teaches each and every element of the claimed invention, and that the prior art provides some teaching, suggestion or motivation, or other legitimate reason, for combining the references in the manner claimed. KSR International Co. v. Teleflex Inc., 127 S.Ct. 1727, 1739-41 (2007); In re Oetiker, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992). In this case, the Examiner has failed to establish a prima facie case of obviousness against independent claims 1 and 15 because, as admitted by the Examiner (Office Action, dated July 9, 2008, at 8, lines 5-16), neither the Hofele’370 Patent, the Terpstra Patent, nor the Smith Patent, teach, or suggest, a “slide mechanism” that comprises a “translatory actuator that drives the feed slide in the carrying direction of the panel” as recited by independent claims 1 and 15 of the above-captioned application, and the Examiner’s application of In re Japiske, 86 U.S.P.Q. 70

(C.C.P.A. 1950) is flawed because the Examiner has erroneously applied Japiske to a hypothetical construct created by the Examiner, and not to a single prior art device, and because the Examiner's rearrangement of parts of the hypothetical construct substantially modifies the Examiner's hypothetical construct in a non-obvious manner.

### **iii. The Hofele'370 Patent**

The Hofele'370 Patent discloses a "transfer device and multistation presses," wherein the transfer device (41) has a suction bridge (46, 47) which extends transversely with respect to a transfer direction and which is guided on its ends by two control arm gearings (59) synchronously along a predetermined transfer curve (See Abstract and Figures 3 and 5 of the Hofele'370 Patent). The Hofele'370 Patent discloses that the control arm gearings (59) are formed by control arms or rods (57), (58) that are connected on the end side with the cross traverse (46) and which, on their respective end situated away from the cross traverse (46), are held in preferably vertically aligned linear axles, in which case the control arms, in respective pairs, enclose the same angle with one another (See Abstract). The Hofele'370 Patent discloses that, by the targeted controlling of the linear axles, arbitrary transfer curves can be traveled within the scope of the range of the transfer device and that all linear axles are directly supported on a stationary frame (See Abstract).

For the Examiner's convenience, Figure 3 of the Hofele'370 Patent is reproduced below.

The Examiner has admitted that the Hofele'370 Patent does not teach, or suggest, (i) a "slide mechanism" that comprises a "translatory actuator that drives the feed slide in the carrying direction of the panel" as recited by independent claims 1 and 15 of the above-captioned application (Office Action, dated July 9, 2008, at 8, lines 5-9). However, this is not the only deficiency in the disclosure of the Hofele'370 Patent. As admitted by the Examiner

(Office Action, dated July 9, 2008, at 9, lines 4-6), the Hofele’370 Patent does not teach, or suggest, (ii) a “translatory actuator that drives the swing slide pivotally fitted to the swinging link mechanism in the carrying direction of the panel” as recited by independent claim 1.

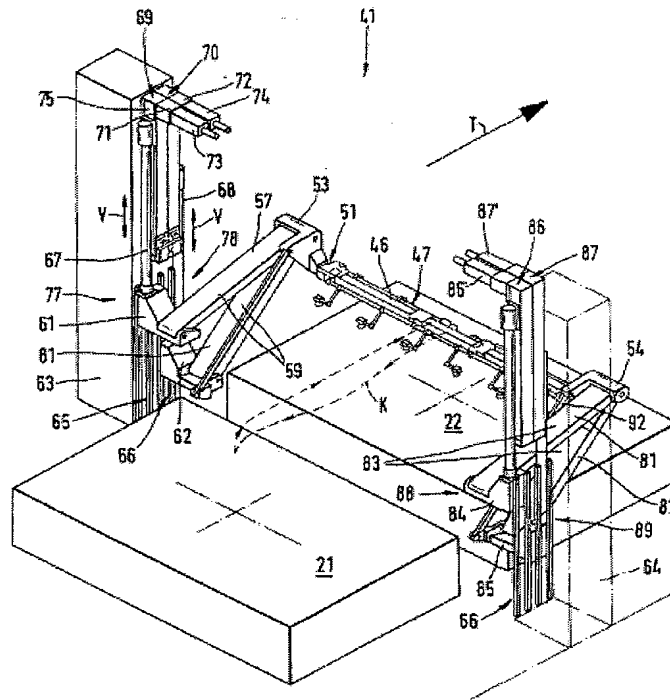


FIG. 3

The Examiner also admits that the Hofele’370 Patent does not teach, or suggest, the subject matter of claims 4 and 6 (Office Action, dated July 9, 2008, at 7, lines 4-5; and at 8, lines 17-19).

#### iv. The Terpstra Patent

The Terpstra Patent discloses a “pick and place device having two parallel axes,” as shown in Figure 1 (reproduced below for the Examiner’s convenience), wherein the apparatus (10) includes an elongated frame (12), first and second carriages (20a), (20b) slidably engaged with the frame, first and second connecting rods (30a), (30b) pivotally engaged with the first carriage (20a) at one end and at least a third connecting rod (30c)

pivotally engaged with the second carriage (20b) at one end, and a gripper (66) pivotally and operatively attached to the connecting rods at their other ends (See Abstract of the Terpstra Patent). The method of operation of the apparatus (10), as disclosed by Terpstra, includes moving the gripper (66) in a first direction (upwardly) by sliding the first and second carriages (20a), (20b) away from each other along the frame (12), moving the gripper (66) in a second direction (laterally), perpendicular to the first direction, by sliding the first and second carriages (20a), (20b) together along the frame in the same direction, and moving the gripper (66) in a third direction (downwardly), opposite to the first direction, by sliding the first and second carriages toward each other along the frame (See Abstract of the Terpstra Patent).

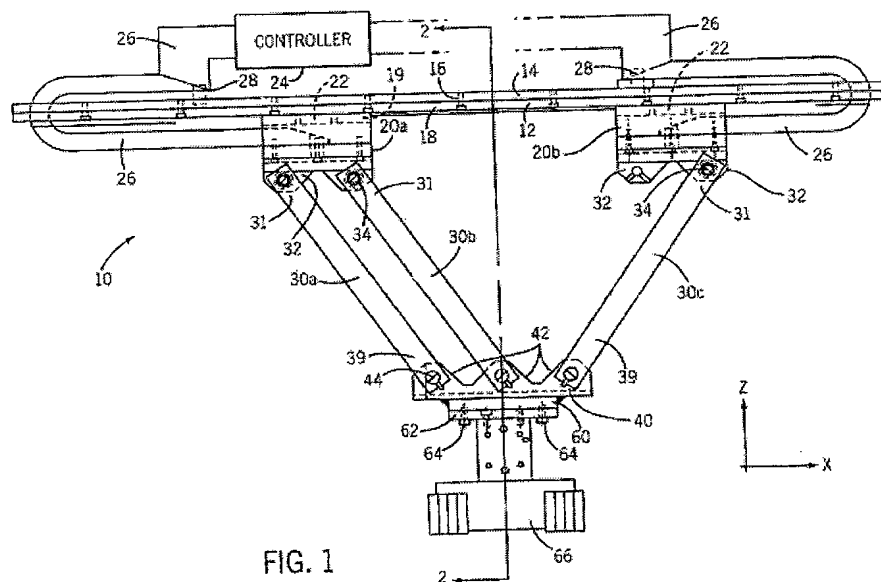


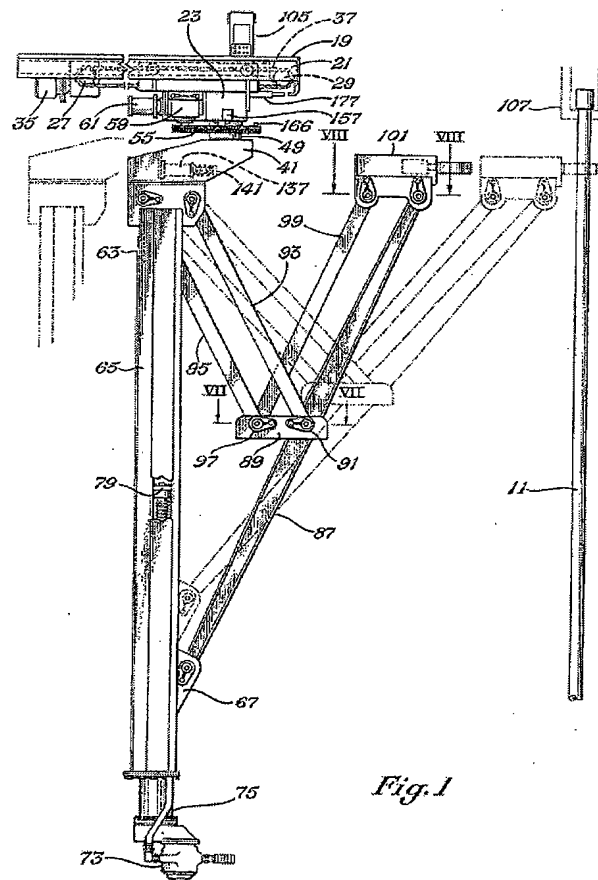
FIG. 1

As admitted by the Examiner (Office Action, dated July 9, 2008, at 8, lines 8-16), the Terpstra Patent does not teach, or suggest, a “slide mechanism” that comprises “a feed slide into which the first link mechanism is pivotally fitted” and “a first translatable actuator that drives the feed slide in the carrying direction of the panel” as recited by claims 1 and 15. As also admitted by the Examiner (Office Action, dated July 9, 2008, at 7, lines 4, to 8, line 4),

the Terpstra Patent does not teach, or suggest, “wherein the first link mechanism includes two arms connecting the intermediate member to the slide mechanism” as recited by claim 4.

**v. The Smith Patent**

The Smith Patent discloses a “pipe manipulator” as shown in Figure 1, which is reproduced below for the Examiner’s convenience. According to Figure 1 of the Smith



*Fig. 1*

Patent, the apparatus for moving stands of pipe (11) in a derrick has a powered turret (41) mounted in a selected position relative to the derrick and a vertical leg (63) supported and rotated by the turret (41), (See Smith Patent, Abstract and col. 4, lines 5-24). A powered dolly (67) is mounted on the vertical leg (63) and moves one end of a power arm (87) to selected positions along the vertical leg (63), and a pipe gripping head (101) is mounted to the opposite end of the power arm (87), (See Smith Patent, Abstract and col. 4, lines 25-45).



According to the Smith Patent, a scissor arm (93) is rotatably connected at one end in mid-region of the power arm (87) and at the other end to the vertical leg (63), (See Figure 1 of Smith Patent), so that the pipe gripping head (101) moves reciprocally in a straight line to engage, move, and disengage stands of pipe (11), (See Abstract of the Smith Patent).

**vi. Summary of the Disclosures**

Neither the Hofele'370 Patent, the Terpstra Patent nor the Smith Patent, either alone or in combination, teach, or suggest, (i) a "slide mechanism" that comprises "a feed slide into which the first link mechanism is pivotally fitted" and "a first translatory actuator that drives the feed slide in the carrying direction of the panel" as recited by claims 1 and 15. The combination of the Hofele'370 Patent, the Terpstra Patent and the Smith Patent also does not teach, or suggest, (ii)

"wherein the first link mechanism is operable to swing back and forth in the carrying direction of the panel due to the slide mechanism and the second link mechanism is operable to swing back and forth in the carrying direction of the panel due to the first link mechanism,

wherein the first link mechanism and the second link mechanism swing back and forth in the carrying direction of the panel by changing a relative distance between the feed slide and the swing side in the carrying direction of the panel, and

wherein the first link mechanism and the second link mechanism move back and forth in the carrying direction of the panel by moving the feed slide and the swing slide in the carrying direction of the panel"

as recited by claim 1. The combination of the Hofele'370 Patent, the Terpstra Patent, and the Smith Patent also does not teach, or suggest, (iii) "wherein the first link mechanism includes two arms connecting the intermediate member to the slide mechanism" as recited by claim 4.

**vii. Claim 4 and the Examiner's Official Notice**

With respect to claim 4, the Examiner combines the Hofele'370 Patent, the Terpstra Patent and the Smith Patent, and then the Examiner additionally contends that "[p]arallel

linkages are well-known and their movement is predictable through the principles of kinematics” (Office Action, dated July 9, 2008, at 7, lines 21-22). Applicants respectfully traverse the Examiner’s apparent “Official Notice” on the grounds that deficiencies in the disclosures of three patents cannot be remedied by what the Examiner contends would be “well-known” in the art.

It is a well-settled proposition that the Patent Office cannot remedy a deficiency in the teaching of one or more references merely by asserting what is “basic knowledge” in the art; rather, the Patent Office must demonstrate all claim limitations based on substantial evidentiary support. In re Zurko, 59 U.S.P.Q.2d 1693, 1697 (Fed. Cir. 2001). Therefore, the Examiner must now produce substantial evidentiary support for the Examiner’s “Official Notice” (e.g., a prior art reference) or withdraw the Section 103 rejection standing against claim 4.

**viii. Claims 1 and 15 and The Examiner’s Improper Use of Japiske**

The Examiner contends, with respect to subject matter presently recited in claims 1 and 15, that it would have been obvious to further modify the Examiner’s hypothetical construct created by the combination of the Hofele’370 Patent, the Terpstra Patent and the Smith Patent so as to rearrange parts on the grounds that the rearrangement of parts allegedly is obvious (Office Action, dated July 9, 2008, at 8, lines 5-16, and at 9, lines 4-12). In support of the Examiner’s contention, the Examiner cites In re Japiske, 86 U.S.P.Q. 70 (C.C.P.A. 1950). The Examiner’s application of In re Japiske to the facts of this case is flawed for the following reasons.

The court’s ruling in In re Japiske, 86 U.S.P.Q. 70, 73 (C.C.P.A. 1950), stands for the proposition that it would be obvious to rearrange parts in a single prior art device when the rearrangement of parts does not modify the operation of the device. The Japiske case does

not stand for the proposition that it would be obvious to rearrange parts of a hypothetically constructed device in a manner that would substantially alter the device's operation.

Specifically, in Japiske, 86 U.S.P.Q. at 70, the claimed device pertained to a hydraulic power press. The prior art Cannon Patent, a single reference, disclosed all of the claimed elements except for the claimed location of the starting switch. In re Japiske, 86 U.S.P.Q. at 73. The court held that it would have been obvious to have rearranged the location of the starting switch because the location of the starting switch did not modify the operation of the device. Id.

In this case, the Examiner combines three patent disclosures, namely, the Hofele'370 Patent, the Terpstra Patent, and the Smith Patent to create a hypothetical construct that falls short of Applicants' claimed invention. The Examiner contends that it would have been obvious to have rearranged the parts of the Examiner's hypothetical construct. The Examiner's obviousness argument is untenable and must be withdrawn because the court's holding in Japiske pertains to modifications of a single prior art device, and not to rearrangement of parts of a hypothetical device (e.g., such as the Examiner's hypothetical device resulting from the combination of parts from the Hofele'370 Patent, the Terpstra Patent, and the Smith Patent). The Examiner's obviousness argument is further untenable and must be withdrawn because the rearrangement of parts asserted by the Examiner allegedly results in a particular movement of parts, which the Examiner must concede is a substantial modification in the operation of the base device (i.e., the device disclosed by the Hofele'370 Patent). Therefore, as a matter of law, the Examiner has misapplied the court's ruling in Japiske to the facts of the present case. Consequently, the Examiner's Section 103 rejection standing against claims 1 and 15 is untenable and must be withdrawn.

For all of the above reasons, the Examiner has failed to establish a prima facie case of obviousness against Applicants' claimed invention.

**ix. The Examiner Has Failed to Establish a Reasonable Expectation of Success of Achieving Applicants' Claimed Invention based on the Combination of the Hofele'370 Patent, the Terpstra Patent and the Smith Patent**

It is a well-settled proposition that a patentable claim may consist of all old elements wherein it is the combination of the old elements that is novel and patentable. Clearstream Wastewater Systems v. Hydro-Action Inc., 54 U.S.P.Q.2d 1185, 1189 (Fed. Cir. 2000). Therefore, assuming *arguendo* that all of the elements of claims 1 and 15 are old (which is not a valid assumption), it does not necessarily mean that the combination of these elements would be obvious. Furthermore, a proper rejection under Section 103 requires showing (1) that a person of ordinary skill in the art would have had a legitimate reason to attempt to make the composition or device, or to carry out the claimed process, and (2) that the person of ordinary skill in the art would have had a reasonable expectation of success in doing so. PharmaStem Therapeutics, Inc. v. ViaCell, Inc., 491 F.3d 1342, 1360 (Fed. Cir. 2007). In the present case, the Examiner has not demonstrated that a person of ordinary skill in the art would have had a legitimate reason to rearrange parts disclosed by the combination of the Hofele'370 Patent, the Terpstra Patent and the Smith Patent, and the Examiner has failed to demonstrate that a person of ordinary skill in the art would have had a reasonable expectation of success of arriving at Applicants' claimed invention even if the combination of the Hofele'370 Patent, the Terpstra Patent and the Smith Patent were made.

Specifically, the Examiner has failed to adduce a legitimate reason for rearranging parts disclosed by the combination of the Hofele'370 Patent, the Terpstra Patent and the Smith Patent because the Examiner has improperly applied the legal rule set forth in In re Japiske, 86 U.S.P.Q. at 73. Furthermore, the Examiner has not shown that even if the combination and

rearrangement of parts asserted by the Examiner were made that the result would be Applicants' claimed invention. As evident from Figure 3 of the Hofele'370 Patent, Figure 1 of the Terpstra Patent and Figure 1 of the Smith Patent, these apparatuses are substantially different. A person of ordinary skill in the art would have no clue how to modify these devices so as to arrive at Applicants' claimed invention.

For all of the above reasons, the Examiner has failed to establish a prima facie case of obviousness against Applicants' claimed invention.

#### IV. CONCLUSION

In view of the present amendment, claims 1-4, 6, 7 and 10-16 are in compliance with 35 U.S.C. § 112. Furthermore, claim 16 is allowable for the reasons of record.

The Examiner has failed to establish a prima facie case of anticipation against independent claims 1 and 15 because, as admitted by the Examiner, the Hofele'370 Patent does not teach, or suggest, a "slide mechanism" that comprises a "translatory actuator that drives the feed slide in the carrying direction of the panel" as recited by independent claims 1 and 15 of the above-captioned application.

The Examiner has failed to establish a prima facie case of obviousness against independent claims 1 and 15 because the combination of the Hofele'370 Patent, the Terpstra Patent and the Smith Patent does not teach, or suggest, a "slide mechanism" that comprises a "translatory actuator that drives the feed slide in the carrying direction of the panel" as recited by independent claims 1 and 15 of the above-captioned application. The Examiner has also failed to establish a prima facie case of obviousness against independent claims 1 and 15 because the Examiner has misapplied the court's ruling in In re Japiske, 86 U.S.P.Q. 70, 73 (C.C.P.A. 1950), and because the Examiner has failed to demonstrate that a person of ordinary skill in the art would have had a reasonable expectation of success of arriving at


Applicants' claimed invention even if the combination of the Hofele'370 Patent, the Terpstra Patent and the Smith Patent were made.

For all of the above reasons, claims 1-4, 6, 7 and 10-16 are in condition for allowance and a prompt notice of allowance is earnestly solicited.

Questions are welcomed by the below-signed attorney for Applicants.

Respectfully submitted,

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the whole region of each press station and liftably disposed in a line direction; a carrier suspended from the lift beam so as to reciprocate between the stations in the line direction; a cross bar incorporated in the carrier;  
5 and a work holding tool attached to the cross bar, and the device simultaneously or intermittently carries workpieces of the stations.

Such a cross bar type carrying device has the following characteristics.

10 (1) A cam driving system or a motion control by an AC servo motor produces a feed motion of a molded panel between press stations.

(2) The panel is carried by a synthesized motion in a feed direction (horizontal direction) and a lift  
15 direction (perpendicular direction), and a vacuum cup attached to a carrying tool referred to as the cross bar adsorbs the panel to carry it.

(3) The cross bars among the press stations are connected to one another in both the feed direction and the  
20 lift direction, and the cross bars are interlocked to perform the same motion.

(4) Feed arms to produce the feed motion between the stations are arranged on a front side or a rear side of a series of feed units each usually constituted of a  
25 carriage connecting the cross bars to each other and a connecting mechanism, and the feed motion is produced by swinging of the arms.



Moreover, in addition to the above cross bar type carrying device, there are proposed panel carrying devices of Patent Document 2, Patent Document 3, ~~Patent Document 4~~ and the like.

5           [Patent Document 1]  
Japanese Patent Application Laid-Open No. 10-328766

          [Patent Document 2]  
Japanese Patent Application Laid-Open No. 7-73756  
10       ~~[Patent Document 3]~~  
~~Japanese Patent Application Laid-Open No. 10-~~  
~~328766~~

          [Patent Document 34]  
U.S. Pat. No. 6,382,400

15           In "Transfer Feeder" of "Patent Document 2", a pair of lift beams vertically moved by a lifter is provided with a plurality of carriers self-operated independently with a linear motor, and the work (panel) can be carried at a high speed by use of the linear motor as a driving source.

20           In "Transfer Press Carrying Device" of [Patent Document 13], the lift beam is provided with a plurality of carriers, and the carriers can carry the works (panels) at the high speed by use of a servo motor as the driving source.

25           In "Transport and Positioning System" of "Patent Document 34" as shown in FIG. 1 includes a driving device 30 provided with a lever mechanism 23 having an output

section 25 to drive and position a cross bar 22. This lever mechanism 23 has a swing arm 24 forming the output section 25 on one end, and this output section 25 is connected to the cross bar 22. The swing arm 24 is  
5 connected to two points of a support point 28 and a driving point 33 at an interval. The interval between the support point 28 and the driving point 33 is shorter than an interval between the output section and the support point. It is to be noted that in this figure, 21 is each work  
10 holding tool attached to the cross bar 22, 32 is a guide rod which connects a slide block 37 to the driving point 33, 41 is a swing motor which swings and drives the guide rod 32, and 45 is a translatory device which vertically moves the slide block 37.

15           According to this constitution, the translatory device 45 vertically moves the slide block 37, and the swing motor 41 swings the guide rod 32 to thereby drive and position a distant end (driving point 33) of the guide rod 32, and a movement of the rod is enlarged at a lever ratio  
20 to drive and position the cross bar 22 to which the work holding tools are attached.

          However, the above devices of [Patent Document 1] and ~~[Patent Document 3]~~ have the following problems.

          (1) Different motions cannot be imparted to the  
25 cross bars.

          (2) Since the cross bars for all the stations are simultaneously moved, the servo motor and a feed driving

unit enlarge.

(3) Since motion curves for the press stations are the same, there occurs a necessity of devising a mold shape in order to avoid interference, and it is difficult to cope with molding of various plates.

Moreover, in a linear motor system of [Patent Document 2], the work can be fed at the high speed by the linear motor, but a separate lift mechanism is required, and the whole structure becomes complicated and enlarged.

In an AC servo system of [Patent Document 13], a high rigidity cannot be obtained owing to a serial link.

In a swing arm system of [Patent Document 34], the swing arm carries the panel. The longer a carrying distance is, the more the arm needs to be lengthened. Deflection or the like of the arm causes vibration.

Furthermore, in a case where the work holding tools are swung (tilted) in order to cope with complicated press molding, a tilting device needs to be separately disposed on the cross bar, and the structure becomes complicated. There are problems that a weight of a movable portion increases, and it becomes further difficult to achieve the high speed.

#### SUMMARY OF THE INVENTION

The present invention has been developed to solve such problems. That is, a main object of the present invention is to provide a panel carrying device which is

capable of: (1) imparting different motions to press stations; (2) easily lightening a movable portion; (3) operating at a high speed with a driving unit having a short stroke, even when a carrying distance is long; and  
5 (4) enhancing rigidity of the movable portion to suppress deflection and vibration. Another object of the present invention is to provide a panel carrying device which is capable of swinging (tilting) a work holding tool while the movable portion remains to be light without adding any  
10 driving unit such as a motor to the movable portion.

According to the present invention, there is provided a panel carrying device which carries a panel, comprising a panel holding device which holds the panel; a second link mechanism connected to the panel holding  
15 device; a first link mechanism pivotally fitted to the second link mechanism; a slide mechanism which moves the first link mechanism in a panel carrying direction; and a swing mechanism which swings the second link mechanism.

According to the above constitution of the present  
20 invention, when the first and second links are moved in the panel carrying direction by the slide mechanism, and swung by the swing mechanism, the panel held by the panel holding device can be carried in a predetermined carrying direction. When the movement in the panel carrying direction is  
25 combined with the swinging, both speeds are added up. Therefore, even when a carrying distance is long, a high-speed operation can be performed. Furthermore, this panel

carrying device can be disposed every press station, and different motions can be imparted to the press stations.

According to a preferable embodiment of the present invention, on opposite sides of the panel holding device, a pair of first link mechanisms, second link mechanisms, slide mechanisms and swing mechanisms are arranged symmetrically with respect to each other.

According to this constitution, the panel can stably be carried.

The second link mechanism includes an output member connected to the panel holding device, an intermediate member constituting an opposite side of the output member and two arms connecting the output member to the intermediate member, which constitute a parallel link.

According to this constitution, when the parallel link is moved, the output member can be lifted and swung (tilted). Since it is not necessary to dispose another driving unit such as a motor on a movable portion, the movable portion can be lightened, and rigidity of the movable portion can be enhanced to suppress deflection and vibration.

The first link mechanism includes two arms connecting the intermediate member to the slide mechanism.

According to this constitution, movement of the slide mechanism in the panel carrying direction can be transmitted to the second link mechanism.

The slide mechanism comprises: a feed slide into

which the first link mechanism is pivotally fitted; and a translatable actuator which drives the feed slide in the carrying direction of the panel.

According to this constitution, the feed slide can be moved in the carrying direction of the panel by the translatable actuator, and the movement of the feed slide can be transmitted to the first link mechanism.

The slide mechanism moves the feed slide in the carrying direction of the panel, while two arms of the first link mechanism are kept in parallel with each other.

According to this constitution, a posture of the intermediate member can be kept, and the panel holding device can be moved in the panel carrying direction while held horizontally via the second link mechanism

The slide mechanism individually drives two arms of the first link mechanism to move the feed slide in the carrying direction of the panel, and tilts the panel holding device.

According to this constitution, the posture of the intermediate member can be tilted, and the panel holding device can be tilted via the second link mechanism.

The swing mechanism comprises: a swinging link mechanism pivotally fitted to the first link mechanism and the second link mechanism; and a translatable actuator which operates the swinging link mechanism.

According to this constitution, when the translatable actuator operates the swinging link mechanism,

the second link mechanism can be swung with respect to the first link mechanism.

5       The translatable actuator of the swing mechanism drives a swing slide pivotally fitted to the swinging link mechanism in the carrying direction of the panel.

      According to this constitution, the translatable actuator can move the swing slide in the carrying direction of the panel, and the movement of the swing slide can be transmitted to the swinging link mechanism.

10       The translatable actuator of the slide mechanism and a translatable actuator of the swing mechanism are arranged.

      According to this constitution, a driving portion to move the slides in the carrying direction of the panel can be disposed to be compact, and it is not necessary to add any driving unit such as a motor to the movable portions of the first and second link mechanisms and the swinging link mechanism.

15       The translatable actuator of the slide mechanism and a translatable actuator of the swing mechanism are a ball screw and a ball nut, timing belts, hydraulic cylinders, a rack and a pinion, or linear motors.

      When these translatable actuators are used, the slides can be linearly operated at the high speed, and correctly positioned.

25       The panel holding device includes a cross bar connected to the second link mechanism, and a work holding

tool attached to the cross bar.

According to this constitution, the second link mechanism moves and swings the cross bar, and the panel holding device attached to the cross bar is allowed to perform a desired operation.

The other objects and advantageous characteristics of the present invention will be apparent from the following description with reference to the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a conventional panel carrying device;

FIG. 2 is a perspective view of a press line including a panel carrying device of the present invention;

FIG. 3 is a perspective view of a first embodiment of the panel carrying device of the present invention;

FIG. 4 is a schematic diagram of the panel carrying device of FIG. 3;

FIGS. 5A to 5E are operation explanatory views of the panel carrying device of FIG. 3;

FIGS. 6A and 6B are lifting operation explanatory views of the panel carrying device of FIG. 3;

FIGS. 7A, 7B and 7C are tilt operation explanatory views of the panel carrying device of FIG. 3;

FIG. 8 is a diagram showing one example of a motion curve of the panel carrying device of FIG. 3;



FIG. 9 is a schematic diagram of a second embodiment of the panel carrying device of the present invention; and

FIG. 10 is a schematic diagram of a third embodiment of the panel carrying device of the present invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

Embodiments of the present invention will be described hereinafter with reference to the drawings. It is to be noted that in each drawing, common parts are denoted with the same reference numerals, and redundant description is omitted.

FIG. 2 is a perspective view of a press line including a panel carrying device of the present invention. In this figure, for the sake of convenience of description, there are shown two press stations 6 on an upstream side and a downstream side and the panel carrying device of the present invention disposed between the stations, but an actual machine is usually provided with a plurality of, about two to five press stations.

The panel carrying device of the present invention is disposed between the press stations 6 and 6 in order to receive a molded material (panel) 1 from the upstream-side press station 6 and carry the material to the downstream-side press station 6.

The panel carrying device of the present

invention includes a pair of feed units 10 symmetrically disposed on opposite sides of each press station that carries the panel 1 to be press-molded in a feed direction X.

5           The pair of feed units 10 are attached between press stands 7 disposed between the upstream-side press station 6 and the downstream-side press station 6. The respective feed units 10 mutually operate symmetrically with respect to the feed direction X, move a cross bar 3 to  
10       which a work holding tool 2 is attached in the feed direction and a vertical direction, and carries the panel 1 to the next press station in order.

          This feed unit 10 is installed between the press stations 6 and 6 by attaching opposite end portions of the  
15       unit to the upstream and downstream press stations 6 or arms (not shown) disposed on the press stands 7 or hanging the unit from the ceiling.

          FIG. 3 is a perspective view of a first embodiment of the panel carrying device of the present invention. In  
20       this figure, each feed unit 10 includes a link mechanism 16, a slide mechanism 20, a swing mechanism 22, and a panel holding device 5.

          In this example, each slide mechanism 20 is constituted of a feed slide 12 and translatory actuators 13,  
25       each swing mechanism 22 is constituted of the translatory actuators 13, a swing slide 14, and a swinging link mechanism 18, and each panel holding device 5 is

constituted of the cross bar 3 and the work holding tool 2.

Each feed slide 12 is constituted of a first feed slide 12a and a second feed slide 12b. The first feed slide, the second feed slide and the swing slide 14 are linearly driven in the feed direction X by the independent translatory actuators 13, respectively.

In this example, the translatory actuators 13 are ball screws and ball nuts, but the present invention is not limited to this example, and they may be timing belts, hydraulic cylinders, racks and pinions, linear motors or the like.

Moreover, the feed units 10 include translatory guides 15 which guide linear driving of the swing slides 14, the first feed slides 12a and the second feed slides 12b, respectively.

Furthermore, the translatory actuators 13 and the translatory guides 15 are attached to fixed portions (main bodies or the like) of the press stations 6, respectively, so that only movable portions (the first feed slides 12a, the second feed slides 12b and the swing slides 14) can linearly be driven in the feed direction X, and correctly positioned by a numerical control or the like.

FIG. 4 is a schematic diagram of the panel carrying device of FIG. 3. As shown in this figure, each link mechanism 16 is constituted of a first link mechanism and a second link mechanism. Here, the second link mechanism is constituted of: an output member 19 connected

to the panel holding device 5; an intermediate member 17 constituting an opposite side of the output member 19; and a pair of second kinks (arms) 16b which connect the output member 19 to the intermediate member 17, and the first link mechanism is constituted of a pair of first links (arms) 16a which connect the intermediate member 17 to the feed slide 12.

The pair of first links 16a have an equal length, have ends a1, a2 (upper ends in the figure) pivotally fitted to the feed slide 12 so as to be rotatable centering on a horizontal axis, and have the other ends a3, a4 (lower ends in the figure) pivotally fitted to the intermediate member 17 so as to be rotatable centering on the horizontal axis. It is to be noted that the pair of first links 16a deviate in a width direction (direction perpendicular to a figure sheet surface), and swing centering on the ends a1, a2 and horizontally freely in the figure.

The pair of second links 16b have an equal length, and become shorter than the first links 16a. The pair of second links 16b have ends a3, a4 (lower ends in the figure) pivotally fitted to the intermediate member 17 so as to be rotatable centering on the horizontal axis, and have the other ends a5, a6 (upper ends in the figure) pivotally fitted to the output member 19 so as to be rotatable centering on the horizontal axis. Furthermore, the pair of second links 16b deviate in the width direction (direction perpendicular to the figure sheet surface), and

swing centering on the ends a3, a4 and horizontally freely in the figure without interfering with the slides 12, 14 and the first links 16a.

In FIG. 4, an interval between the pivotally fitted points a3 and a4 of the intermediate member 17 is set to a length L0 equal to an interval between the pivotally fitted points a5 and a6 of the output member 19.

According to this constitution, two parallel links a1, a2, a4 and a3 and a4, a3, a5 and a6 are constituted. Even when the first links 16a and the second links 16b are swung, the output member 19 can be positioned in parallel with the feed slide 12 (i.e., X-direction), and can be held horizontally without tilting the cross bar 3 attached to this member.

It is to be noted that here, there has been described a case where the link mechanism 16 constitutes the parallel links, but the parallel links do not have to be necessarily constituted depending on a shape of the output member 19 or a way to attach the cross bar 3.

Each swinging link mechanism 18 is constituted of a third link 18a and a fourth link 18b. The third link 18a has one end b1 (upper end in the figure) pivotally fitted to the swing slide 14 so as to be rotatable centering on the horizontal axis, and a part b2 (middle point) of the link is pivotally fitted to the first link 16a. The fourth link 18b is pivotally fitted to the other end b3 (lower end in the figure) of the third link 18a and an extended end b4

(lower end in the figure) of the second link 16b so as to be rotatable centering on the horizontal axis.

Moreover, in this example, an interval between the pivotally fitted points b2 and b3 is set to be equal to an interval between the pivotally fitted points a3 and b4. Therefore, a third parallel link b2, b3, b4 and a3 is formed, and the third link 18a is constantly parallel to the second links 16b.

It is to be noted that the swinging link mechanism 18 is not limited to this example, and may have another constitution as long as the first links 16a and the second links 16b can be swung. Unlike this example, for example, the fourth link 18b may be pivotally fitted to a middle point between the third link 18a and the second links 16b. Alternatively, the fourth link may be connected to a link on the opposite side.

For example, as shown in FIG. 9, the link 18a is rotatably pivotally fitted to the middle point b3 between the upper members a1 and a3 of the first links 16a, and the link 18b is rotatably pivotally fitted to the pivotally fitted point a5 of the output member. In this case, as compared with the embodiment of FIG. 4, a linear movement distance of the swing slide 14 lengthens, but the third link 18a and the lower second link 16b are two-point supported by the points b1 and b2, and a3 and a5, respectively. Since the link portions are not bent, the members can be lightened.

According to this constitution, when the swing slide 14 is simply linearly driven in the feed direction X, the first links 16a can be swung via the third link 18a, and the second links 16b can be swung via the fourth link 18b. Therefore, the swinging link mechanism 18 does not include any driving unit, a movable portion can be lightened, and rigidity of the movable portion can be enhanced to suppress deflection and vibration.

FIGS. 5A to 5E are feed operation explanatory views of the panel carrying device of FIG. 3. In this figure, 6a is a panel holding position of the upstream-side press station 6, and 6b is a panel mounting position on the downstream side. This figure shows a case where the first feed slide 12a, the second feed slide 12b and the swing slide 14 are linearly driven in the feed direction X, while retaining an interval L between the pivotally fitted points of the first feed slide 12a and the second feed slide 12b as an equal length  $L_0$  with respect to the interval  $L_0$  between the pivotally fitted points of the intermediate member 17 or the output member 19.

FIG. 5A shows a position of the upstream-side press station 6 lifting the panel. From this position, the first feed slide 12a and the second feed slide 12b are linearly driven toward the upstream side, while retaining the interval L of the pivotally fitted points of the first feed slide and the second feed slide as the equal length  $L_0$ . Moreover, the swing slide 14 is brought close to the first

feed slide 12a as shown in FIG. 5B.

Moreover, the first feed slide 12a and the second feed slide 12b are further linearly driven toward the upstream side. Moreover, the swing slide 14 is linearly driven to a position where the slide is superimposed on the second feed slide 12b (deviates in an axial direction) as shown in FIG. 5C.

Furthermore, the first feed slide 12a and the second feed slide 12b are further linearly driven toward the upstream side. Moreover, the swing slide 14 is linearly driven rightwards from the first feed slide 12a as shown in FIGS. 5D, 5E. FIG. 5E shows a position of the downstream-side press station 6 lifting the panel.

As shown in FIGS. 5A to 5E, in the constitution of the present invention, the cross bar 3 to which the work holding tool 2 has been attached is attached to a part of the link mechanism 16, and the cross bar 3 is fed and lifted or lowered by linear movements of the feed slide 12 and the swing slide 14 and swing movements of the link mechanism 16 and the swinging link mechanism 18. Therefore, even when a carrying distance is long, a high-speed operation can be performed with a driving unit having a short stroke.

For example, when an interval between the press stations is about 6.5 m, the feed slide 12 and the swing slide 14 linearly move as much as a half of the interval or less, about 3 m. Therefore, even when carrying at a high



speed of 10 m/sec or more is demanded, the speed of the driving unit can be halved or less, and the high-speed carrying can easily be realized using the highly practicable translatory actuators 13.

5                FIGS. 6A and 6B are lifting operation explanatory views of the panel carrying device of FIG. 3. In the figures, FIG. 6A shows a position of the upstream-side press station 6 lifting the panel, and FIG. 6B shows a position of the upstream-side press station 6 before the station lifts the panel, that is, when the station holds the panel. A thin line of FIG. 6B shows the position of FIG. 6A.

10                As shown in this figure, while retaining the interval L between the pivotally fitted points of the first feed slide 12a and the second feed slide 12b as the equal length L<sub>0</sub>, the slides are linearly driven on the downstream side. Moreover, when the swing slide 14 is brought close to the first feed slide 12a to reduce a distance between the swing slide 14 and the first feed slide 12a, the output member 19 moves up. When the distance between the swing slide 14 and the first feed slide 12a is increased, the cross bar 3 moves down. Therefore, as shown in FIG. 6B, without changing the positions of the slides in the feed direction X, the output member 19 and the cross bar 3  
20                attached to this member can be lifted without being tilted. It is to be noted that this also applies to the downstream-side press station 6.

FIGS. 7A, 7B and 7C are tilt operation explanatory views of the panel carrying device of FIG. 3. In the figures, FIG. 7B shows that the interval L between the pivotally fitted points of the first feed slide 12a and the second feed slide 12b is retained as the length L0 equal to that of the intermediate member 17, FIG. 7A shows that the interval L is set to be shorter than L0, and FIG. 7C shows that the interval L is conversely set to be longer than L0. In the figures, the positions of the second feed slide 12b and the swing slide 14 are fixed in the feed direction.

As shown in the figures, when feed amounts of the first feed slide 12a and the second feed slide 12b are varied, the interval L between the pivotally fitted points of the feed slide is set to be shorter than the interval L0 between the pivotally fitted points a of the intermediate member 17. Alternatively, when the interval is set to be longer than this interval L0, the output member 19 is swung with respect to the feed slide, and the work holding tool attached to this member can be swung (tilted).

FIG. 8 is a diagram showing one example of a motion curve of the panel carrying device of FIG. 3. As shown in this figures, when the above-described operations of FIGS. 5A to 5E and 6 are combined, the material (panel) 1 molded in the upstream-side press station 6 is held and lifted by the work holding tool attached to the output member 19, carried in the feed direction, and lowered by the downstream-side press station 6 so that the panel can

be positioned in a molding position in a mold. Thereafter,  
the panel is left in the downstream-side press station 6,  
and the output member 19 is returned to a predetermined  
stand-by position to perform the molding in the press  
stations 6.

FIG. 10 is a schematic diagram of a third  
embodiment of the panel carrying device of the present  
invention. In this figure, a feed slide 12 is constituted  
of a first feed slide 12a and a second feed slide 12b which  
are connected to each other. An interval between pivotally  
fitted points of the first feed slide 12a and the second  
feed slide 12b is set to L0 equal to a length of an  
intermediate member 17. The first feed slide 12a and the  
second feed slide 12b are linearly driven in a feed  
direction X by a single translatory actuator. Another  
constitution is similar to FIGS. 2, 3.

It is to be noted that the first feed slide 12a  
and the second feed slide 12b may deviate in a width  
direction (direction perpendicular to the figure sheet  
surface), but may be arranged along the same line without  
being shifted in the width direction although not shown.

According to this constitution, the first feed  
slide 12a and the second feed slide 12b are connected to  
each other, and linearly driven in the feed direction by  
the single translatory actuator. Therefore, when the work  
holding tool does not have to be swung (tilted), a driving  
mechanism can be simplified.

According to the above constitution of the present invention, a pair of mutually symmetrical feed units 10 are arranged on opposite sides of each press station in the panel feed direction X. The feed units 10 can impart  
5 different motions to the press stations.

Moreover, each feed unit 10 is constituted of the feed slide 12 and the swing slide 14 linearly driven in the feed direction X and the link mechanism 16 and the swinging link mechanism 18 pivotally fitted to the slides.

10 Therefore, the movable portions (the link mechanism and the swinging link mechanism) do not have any driving unit, the movable portions can easily be lightened, and the rigidities of the movable portions can be enhanced to suppress the deflection and the vibration.

15 Furthermore, the cross bar 3 to which the work holding tool 2 is to be attached is attached to a part of the link mechanism 16, and the cross bar 3 is fed and lifted or lowered by the linear movements of the feed slide 12 and the swing slide 14 and the swing movements of the  
20 link mechanism 16 and the swinging link mechanism 18.

Therefore, even when the carrying distance is long, the high-speed operation can be performed by the driving unit having a short stroke.

25 As described above, according to the present invention, the following effects can be obtained.

(1) Since a linear feed movement is combined with a rotation movement, a slide stroke of an actuator can be

set to be shorter than a feed distance, and driving portions such as ball screws, screws and translatory actuators can easily be designed.

5 (2) Since a movable portion does not have any power source such as a motor, miniaturizing and lightening of the movable portion can be realized.

10 (3) When linear movements of the actuators of three systems on one side are combined, a carrying portion on a distant end of a feed unit can realize various movements such as feed of a material in a horizontal direction, vertical positioning (lifting) in a vertical direction and a free posture control (tilt) at a time when the material is placed in a mold.

15 Therefore, the panel carrying device of the present invention have excellent effects that the device is capable of: imparting different motions to press stations; easily lightening the movable portion; operating at a high speed with a driving unit having a short stroke, even when a carrying distance is long; enhancing rigidity of the movable portion to suppress deflection and vibration; and  
20 further swinging (tilting) a work holding tool while the movable portion remains to be light without adding another unit to the movable portion.

25 It is to be noted that the present invention is not limited to the above-described embodiments, and can needless to say be modified variously within the scope of the present invention.